

CHAPTER 1

GENERAL

1-1. Purpose. This manual provides criteria and guidance for the design of structures to resist the effects of earthquakes.

1-2. Scope. This manual is a general approach for the seismic design of buildings, including architectural components, mechanical and electrical equipment supports, some structures other than buildings, and utility systems. Primary emphasis is given to the equivalent static force design procedure.

1-3. References. Appendix A contains a list of references used in this manual.

1-4. Design criteria. Preparation of seismic designs will be in accordance with the criteria and design standards herein.

a. The seismic design and detail requirements in this manual are based on the Structural Engineers Association of California (SEAOC) *Recommended Lateral Force Requirements and Commentary*. References to SEAOC are made throughout this manual and are discussed to expand or explain the application of SEAOC to the design of military facilities. It is necessary to have the requirements portion of that document, chapters 1 through 6 to use in conjunction with this manual. Appendix B contains information concerning the SEAOC manual.

b. Criteria and design standards in the agency manuals for ordinary or nonseismic design are applicable to seismic design except where criteria in this manual are more stringent. Details of construction shown in this manual represent those acceptable for conforming systems. Site adaptation of standard drawings will include design revisions for the seismic area as required. In overseas construction, where local materials of grades other than those stated herein are used, the working stresses, grades, and other requirements of this manual will be modified as applicable.

1-5. Organization of manual. The general provisions for seismic design are covered in this manual by chapters 2, 3, and 4: chapter 2 provides an introduction to the basic concepts of seismic design; chapter 3 contains the seismic design criteria; and chapter 4 provides a guide to the application of the seismic design criteria. Chapters 5 through 10 are concerned with seismic design in relation to structural materials, elements, and components, including foundations. Chapters 11

and 12 cover seismic provisions for nonstructural components such as architectural, mechanical, and electrical elements. Chapter 13 covers structures other than buildings, and chapter 14 gives some guidelines for designing for the effects of earthquakes on utility systems. The appendices provide examples of design calculations.

1-6. Preparation of project documents.

Design analysis, drawings, specifications, and cost estimates will conform to agency standards and the following additional requirements:

a. Design analysis. The design analysis, to be furnished with the final plans, will include:

(1) *Basis of design.* The first part of the analysis, called the basis of design, will contain the following specific information:

(a) A statement of the seismic zone for which the structure will be designed.

(b) A description of the structural system selected for resisting lateral forces and a discussion of the reasons for its selection. If irregular features are involved, the application of configuration requirements will be established.

(c) A statement regarding compliance with this manual and the selected values of the design parameters R_w , C , S , T , I , and Z as defined in subsequent chapters.

(d) A statement defining the assignment of responsibilities for seismic design of structural and nonstructural elements and components of the building by architectural, mechanical, electrical, and other consultants.

(e) A description of any possible assumed future expansion for which provisions are made.

(2) *Computations.* The design analysis will include seismic design computations for the stresses in the lateral force resisting elements and their connections, and for the resulting lateral deflections and interstory drifts.

(3) *Computer analyses.* When computers are used to perform seismic design calculations, the analysis will include:

(a) *Computer applications.* Copies of computer data, accompanied by diagrams that identify supports, joints, and members according to the notations used in the data listings, will form integral parts of the design calculations in lieu of manual computations otherwise required. These listings will be augmented with intermediate results where applicable, so that sufficient information is available to permit manual checks of final results.

(b) *Information.* The names and descriptions of the computer programs will be provided. Other information will be in sufficient detail so the method of solution and limitations may be identified. Designers are encouraged to use well-documented, widely accepted structural analysis programs that are continuously maintained and enhanced by an experienced computer service organization.

(c) *Confidential or proprietary information.* The use of confidential or proprietary information is not desirable and should be avoided. If proprietary or confidential computer programs are used, it is the responsibility of the designer to provide suitable documentation to the government. To verify the accuracy of the proprietary or confidential program, sample problems should be solved and the results compared with results from a widely accepted structural analysis program.

b. *Drawings.*

(1) Preliminary drawings will contain a statement that seismic design will be incorporated. The basis of design submitted with these drawings will give full information concerning the seismic loads that will be used and the assumptions that will be made in carrying out the seismic design.

(2) Construction drawings will include:

(a) A statement of the seismic zone and the R_w , C, S, T, I, and Z values.

(b) Wall elevations for all concrete and masonry shear walls showing openings and special reinforcing.

c. *Specifications.* Specifications will use applicable guide specifications or supplements. Specifications will include a QA plan identifying all elements of the lateral force resisting system requiring special

inspection and testing.

d. *Cost estimates.* The special provisions required for seismic design generally result in an increase in construction costs of 1 percent to 5 percent. The amount of this increased cost depends on the overall concept and configuration of the building system and the geographical location of the building site. In some cases, a small increase in the number of reinforcing bars, anchors, or stiffener plates or a small increase in the amount of weld material may be all that is required to meet the seismic design provisions. In other cases, however, where the basic concept or configuration of the building does not provide an efficient system of lateral force resistance, the additional costs to provide seismic force resistance can be appreciable. In geographical locations where the local construction industry is not experienced with the special details of earthquake resistant construction, the differential costs for seismic design will generally be greater than they will in areas such as California, where this type of construction is the norm. For example, the premium for seismic construction will be higher for *reinforced* masonry, *special moment resisting* reinforced concrete frames, and *special moment resisting* steel frames in areas where these types of construction are not common.

e. *Items to be designed by the contractor.* For these items, the drawings and specifications will specify requirements for the following:

(1) Qualifications of the contractor's engineer.

(2) Criteria for the design: governing documents, required loads, limiting deflections, performance objectives.

(3) Mechanism for review and basis for acceptance of the proposed design.